Chapter 2

Reconnaissance and Preliminary Investigations

This chapter provides basic information on bridge-reconnaissance operations. It focuses on providing engineers with the information needed to allow them to obtain technical bridge-site data. The time and availability of qualified engineers will determine which type of bridge reconnaissance to use—hasty or deliberate.

HASTY RECONNAISSANCE

2-1. The hasty method limits obtaining bridge-site data because of time or other factors. At a minimum, the data should include the serial number, the geographic location, the MLC (if posted), the overhead clearance, and the available bypasses of the bridge. *FM 5-170* includes details of hasty reconnaissance methods. For military purposes, a hasty reconnaissance primarily concerns civilian bridges, which range from simple steel- or concrete-stringer bridges to multispan arch, truss, or suspension bridges. Army engineers usually classify military bridges (including floating, standard, and nonstandard fixed bridges) after constructing them.

DELIBERATE RECONNAISSANCE

2-2. The deliberate method requires time and qualified personnel to analyze the reconnaissance information for either repairing or demolishing a bridge. Proper reconnaissance prevents unnecessary repairs or construction delays. When possible or if required, collect and record data on the approaches, the type of crossing or obstacles, the abutments, the intermediate supports, the bridge structure, any repair information, any demolition information, and any alternate crossing sites. Record this data on *DA Form 1249* as shown in *FM 5-170*.

REPAIR OR RECONSTRUCTION

2-3. Use existing bridges whenever possible. Bridges located on established routes require less work on the approaches, which saves time and material and permits the release of tactical bridging assets to other areas. Also, bridge repair often eliminates long detours and difficult bypasses. If necessary, determine how the characteristics of the gap will affect additional bents or pile piers and where there are alternate sites.

2-4. Use *DA Form 1249* to record and report the data needed to repair or reinforce an existing bridge. The data should include—

- The type of bridge; the number and width of lanes; the number, length, and arrangement of spans; and the length of the panels.
- The height above the gap, the overhead clearance for vehicles, and the bridge's classification.
- The general condition of the bridge.
- The watercourse's width and depth; current velocity; direction of the flow; type and estimated bearing capacity of the bottom; and the bank's height, slope, and nature.
- Specifics on the access roads and approaches, particularly the work estimates on approaches and access roads between the existing road network and the bridge.
- Sites near the bridge for turnarounds, access, and concealment.
- Types, dimensions, and relative positions of the abutments and intermediate supports.
- The number, type, size, and spacing of stringers in each span.
- The type and dimensions of the decking.
- The number and types of local boats and barges.
- The location of locks, dams, and so forth in the vicinity.
- Methods and work estimates used to restore and strengthen the damaged bridge to its original specified capacity.
- A large-scale sketch of the site showing concealment, turnarounds, parking areas, detours, and expedient crossings.

NEW-BRIDGE CONSTRUCTION

2-5. New-bridge construction requires preliminary information that is adequate for planning and design. The construction method used will depend on site constraints and the availability of equipment, materials, and manpower. A thorough reconnaissance can prevent needless return trips to the proposed site. Before making any final decisions pertaining to construction, consider the following factors:

- **Access roads.** Locate the bridge to take advantage of the road network on both sides of the watercourse or gap.
- **Approach roads.** Study the construction required for bridge approaches at each site. Often, the time required to construct approaches is the controlling factor in site selection. Approaches should be straight and gently sloped. Include a turnaround near the bridge site that will allow oversize and overweight vehicles to leave the site without obstructing traffic.
- **Width.** Determine the width of the watercourse at normal and flood stages. Check with local authorities for information on frequency and severity of floods.
- **Banks.** Estimate the character and shape of the banks accurately enough to establish abutment positions. The banks should be firm and

level to limit the need for extensive grading. Select straight reaches to avoid scour.

- **Flow characteristics.** Determine the stream velocity and record erosion data on the rise and fall of the water. A good bridge site has a steady current that flows parallel to the bank at a moderate rate of about 3 feet per second (fps).
- **Stream bottom.** Record the characteristics of the bottom. This will help in determining the type of supports and footings required (soil samples might be needed).
- **Elevation.** Determine and record accurate cross-sectional dimensions of the site for determining the bridge's height. Note any required clearances if the bridge will pass over existing roads, railroads, or navigable waterways.
- **Materials.** Use standard military materials when possible for quality and speed of construction. Steel is preferred over timber. If military materials are not available, use locally procured items of adequate quality. Local sources might include standing timber, nearby demolished buildings or bridges, and local markets.

SITE REQUIREMENTS

2-6. Desirable bridge sites have certain terrain and stream characteristics. These include—

- Concealment for personnel and equipment on both sides of the gap.
- Firm banks to support the abutment and provide good approaches. High banks require excessive grading and low banks might be threatened by flooding, which requires that the bridge be lengthened.
- Terrain that will permit rapid construction of short approach roads to the existing road network on both sides of the gap.
- Access routes to the road network (necessary for transporting equipment to the assembly sites).
- Turnarounds for construction equipment.
- Large trees or other holdfasts near the banks for fastening anchor cables and guy lines.
- A steady, moderate current that is parallel to the bank.
- A bottom that is free of snags, rocks, and shoals and is firm enough to permit some type of spread footing.
- Several assembly sites for floating portions of the bridge, either upstream or downstream. If the current is strong, locate all assembly sites upstream from the bridge site.

2-7. *Figure 2-1, page 2-4,* shows an example of a construction-site layout for a proposed bridge project. Determine the final location of the bridge by following the three stages discussed below.

STAGE ONE

2-8. Develop a detailed study of the proposed site by using topographic and geologic maps and air photos (if available). Stereo air photos with a scale of

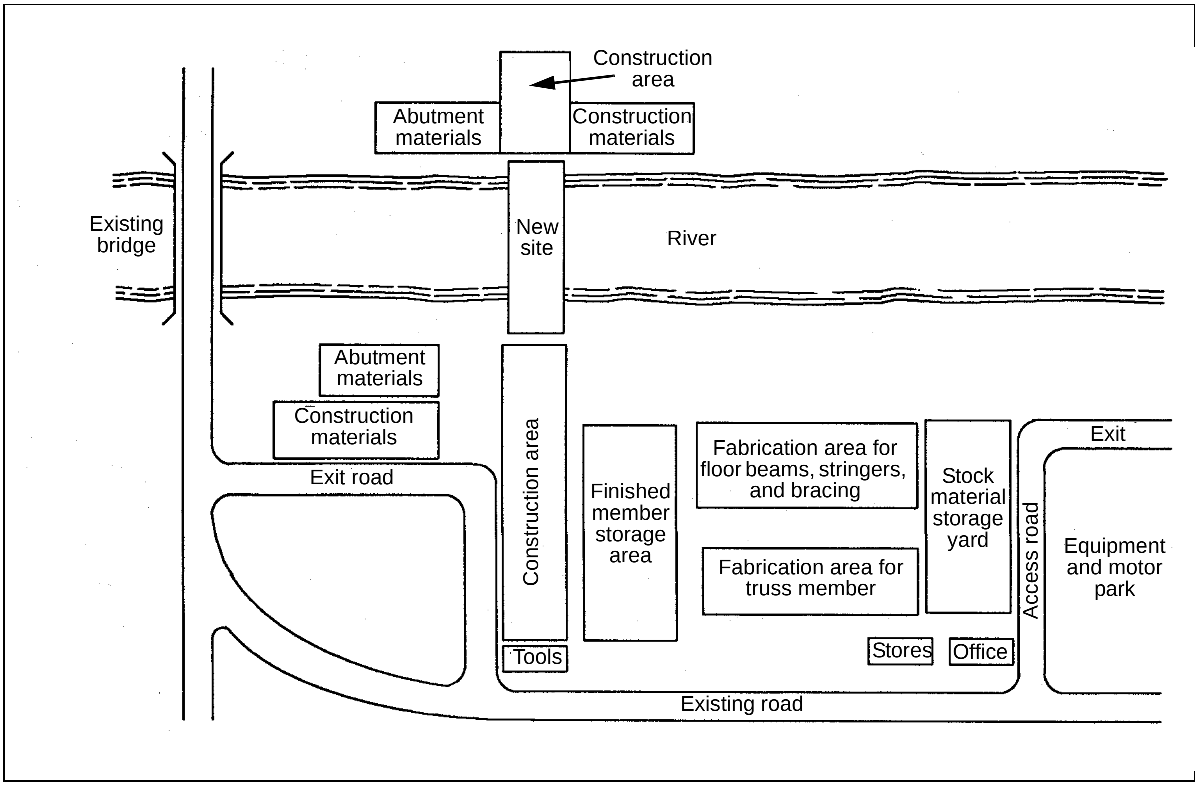

Figure 2-1. Construction-Site Layout

1:20,000 or smaller are particularly useful for a map study. These photos usually indicate stream conditions (such as channel locations and bar positions). Air photos often enhance a reasonably accurate estimate of bank-soil conditions.

STAGE TWO

2-9. Perform an on-ground reconnaissance. Some, if not all, of the following factors will influence the ultimate location and design of the bridge:

- Location of the existing road network.
- Availability of useful abutments and piers from a demolished bridge.
- Location of an existing channel that might restrict pier construction or require minimum clearance for navigation.
- Soil or rock profile of the bottom as it affects the type and position of bridge piers.
- Availability of stringer material (in required lengths and sizes) for the required spacing of intermediate supports.
- Site restrictions (such as existing structures) that might influence the location of the centerline.
- Availability of construction resources (especially labor and equipment).

STAGE THREE

2-10. Begin detailed planning. Establish horizontal and vertical controls at each end of the proposed centerline. Prepare a topographic map of about 1:250 with a contour interval of 2 feet. Use this map to plot design constraints such as the location of obstacles, required distances, and necessary elevations. Determine any unique physical characteristics of the site that would limit normal construction methods. Also, prepare a soil profile of the proposed centerline of the bridge to use in designing the foundation *(Figure 2-2).*

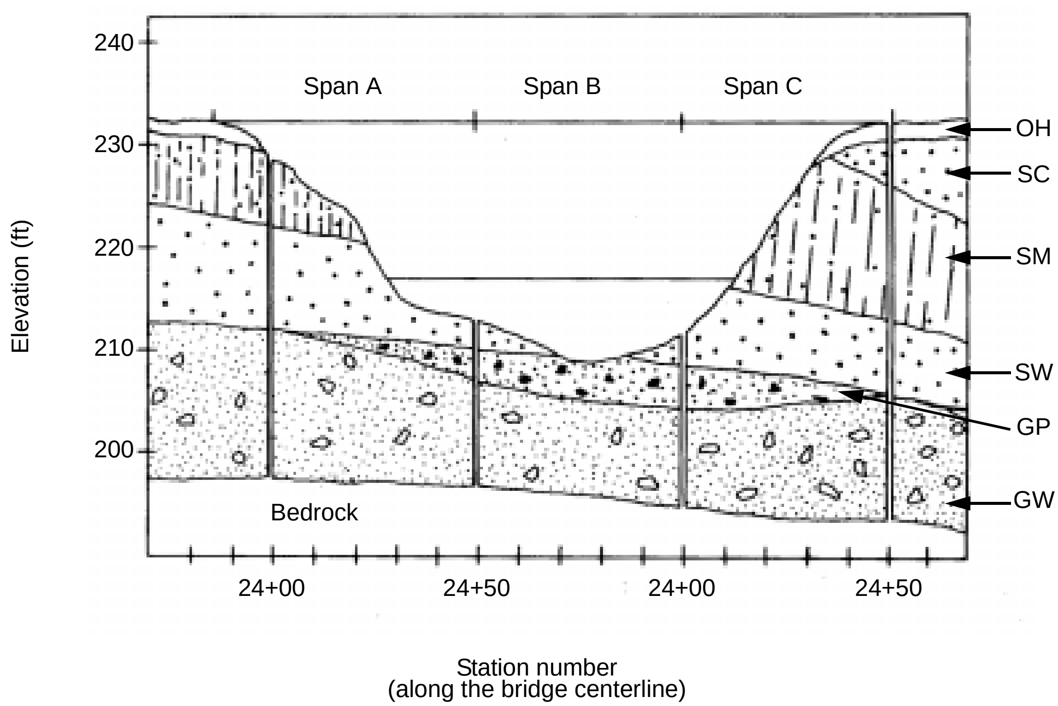

Figure 2-2. Soil Profile

2-11. A soil profile represents the properties of soil layers. Take borings along the bridge's centerline, assuming that the soil a short distance away has the same characteristics. Because piers and abutments support substantial loads, take borings at each pier to determine soil properties. See *FM 5-430-00-1* and *FM 5-410* for more information on soil analysis and exploration.

2-12. A test pit (dug deep enough to inspect the soil visually) yields the most accurate soil profile. Test pits are not well suited to military bridge-construction purposes. Unless the anticipated loads are unusually great and considerable time is available to excavate and sheet the pit, do not use this method because it is expensive. Instead, obtain soil samples using an auger, a sounding rod, or a penetrometer.

SURVEY CONTROL

2-13. A survey of a proposed bridge site furnishes accurate information from which to develop the bridge's layout, to requisition material, and to outline the construction procedure. *FM 5-233* gives further details on surveying for bridge construction. Submitted as drawings, a survey shows the site's plan and elevation, with a graphical presentation of subsurface conditions. The complexity of the bridge-construction project will determine the amount and accuracy of survey control. Survey considerations are discussed in more detail in *Chapter 10*.

SURVEY DRAWINGS

2-14. Include a location map in the survey drawings that shows the relationship of the site to the communication routes and the bivouac areas for construction personnel. Also show sources of sand, gravel, timber, and other construction materials. Include a detailed site plan *(Figure 2-3)* with a scale no greater than 1:480. The plan should show the—

- Alignment of the structure and the tentative position of bents or piers and abutments.
- Position and the details of piers and abutments of any existing structure.
- Course of the stream, the bank lines, and the direction and distribution of flow.
- Natural features (such as drainage courses, eroding banks, exposed rock ledges, trees, and wooded areas).
- Existing installations (such as power and utility lines, sewers, buildings, roads, dikes, walls, and fences).
- Contour elevations extending at least 100 feet to each side of the bridge's centerline and 200 feet beyond each abutment.
- Location of all the benchmarks and their elevations, all reference points, and all borings and soil tests.

2-15. Include a profile of equal horizontal and vertical scales of not less than 1:480. The profile should show the—

- Ground surface on the centerline of the proposed bridge, extending not less than 200 feet beyond each abutment.
- Elevation of high and low water.
- Foundation materials as disclosed by test pits or borings.

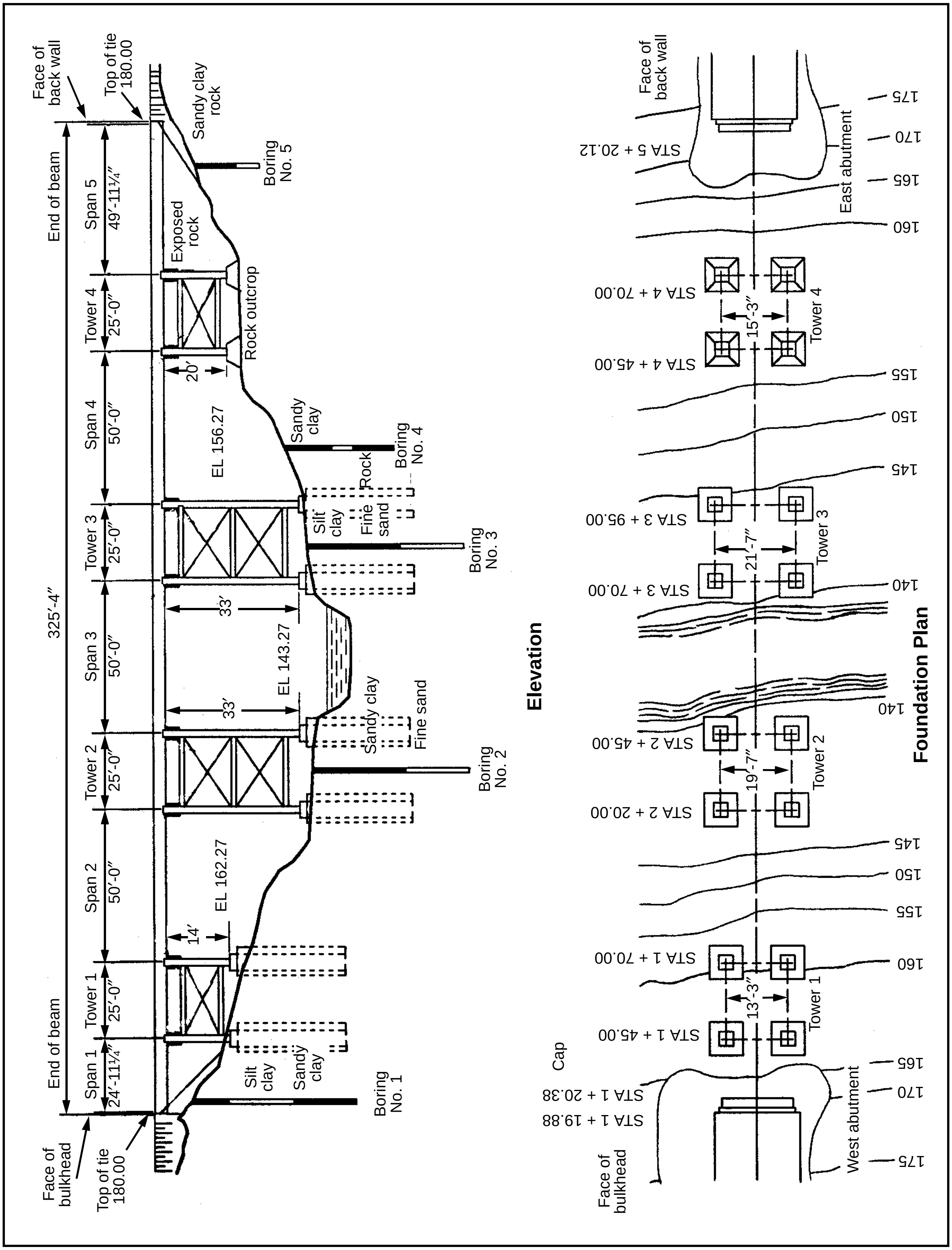

Figure 2-3. Site Plan